UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 1 Examination in Engineering: May 2022

Module Number: CE1202 **Module Name: Introduction to Infrastructure Planning**

[Three Hours]

[Answer all questions. Each question carries **FIFTEEN** marks]
All Standard Notations denote their regular meanings

Q1.

a) Explain the meaning of the following terms:
   i Datum
   ii Temporary Bench Mark
   iii Back sight
   iv Intermediate sight

[4.0 Marks]

b) The levels recorded in meters during a levelling exercise between stations A and E are given in Table Q1. The reduced levels of TBM1 and TBM2 are 567.550 m and 576.810 m, respectively. Find the correct reduced levels of all points using the height of collimation method, stating all the necessary checks.

[11.0 Marks]

Q2.

a) i What are the pole ranging methods in Engineering surveying?
   ii Explain the above ranging methods with the aid of sketches.

[5.0 Marks]

b) A base line was measured in catenary in four lengths giving 27.926, 29.973, 28.966, and 22.536 m. The differences of level were 0.45, 0.60, 0.30, and 0.45 m respectively. The length of the line was measured by using stepping, where a suspended chain of nominal length 30.0 m was used to measure the horizontal length in catenary between two staff locations at the ends of the chain.

It was later found that chain used for the measurements was actually 29.8 m long. The temperature during the observations was 10°C and the straining mass was 15 kg. The tape was standardized as 30 m, at 20°C, on the flat with a straining mass of 5 *kg*. The coefficient of expansion was 0.000011 per °C, the mass of the tape was 1 *kg*, and the cross-sectional area was 3 mm^2. E = 210 kN/mm^2. Gravitational acceleration g = 9.80665 m/s^2. Calculate the corrected length of the base line.

[10.0 Marks]

Q3.

a) Explain four basic system engineering concepts that should be considered in the design and construction of civil engineering structure such as roads, buildings, and harbors.

[6.0 Marks]

b) Briefly explain six characteristics that can be used to describe a civil engineering system.

[6.0 Marks]

c) Define the following terms giving an example for each.

i Tension member

ii Compression member

iii Flexural member

[3.0 Marks]

Q4.

a) i Construction materials for civil engineering construction should be carefully selected considering many factors. Name five of those factors.

[2.5 Marks]

ii Explain three factors which affect to the quality of concrete.

[1.5 Marks]

iii Explain the purpose of conducting cube crushing test and slump test for concrete.

[1.0 Mark]

b) i Discuss five different advantages of using steel as a construction material.

[2.5 Marks]

ii Draw the typical stress-strain diagram and mark the important features.

[2.5 Marks]

c) i Show the dimensions of a standard burnt brick with the aid of a sketch.

[1.0 Mark]

ii Draw the elevation view and plan view of a stretcher layer and a header layer for a 9″ thick brick wall constructed using English bond pattern.

[3.0 Marks]

iii Name two sustainable building materials that can be used to replace burnt bricks or cement blocks.

[1.0 Mark]

Table Q1: Data for levelling

Instrument station	1st Reading	2nd Reading	3rd Reading	4th Reading
A	2.430 (TBM1)	2.310	2.015	0.970
B	3.070	3.270	2.040	0.425
C	2.930	1.930	1.170	
D	2.420	2.210	1.370	
E	3.255	2.070	0.930 (TBM2)	

Useful Equations

$$t_a = \frac{C_t}{KL} + t_s$$

$$C_t = KL\Delta t$$

$$E_F = \frac{K_1E_A + K_2E_B + K_3E_c}{K_1 + K_2 + K_3}$$

$$N_F = \frac{K_1N_A + K_2N_B + K_3N_c}{K_1 + K_2 + K_3}$$

$$\sigma_{\bar{x}} = \frac{S}{n^{\frac{1}{2}}}$$

$$C_T = L\,\frac{\Delta T}{AE}$$

$$C_\theta = -\frac{h^2}{2L}$$

$$C_M = -\frac{LH}{R}$$

$$k = \frac{AB_S}{AB_U}$$

$$\theta = (\emptyset_{AB})_S - (\emptyset_{AB})_U$$

$$S = \left(\frac{\sum(x_i - \bar{x})^2}{n-1}\right)^{\frac{1}{2}}$$

$$C_s = -\frac{w^2L^3}{24T^2}$$

$$C_s = -\frac{w^2L^3}{24}\left(\frac{1}{T_A^2} - \frac{1}{T_S^2}\right)$$

$$K_1 = \frac{1}{(\cot a - \cot x)}$$

$$K_2 = \frac{1}{(\cot b - \cot y)}$$

$$K_3 = \frac{1}{(\cot c - \cot z)}$$

$$C_\theta = -L\,(1 - cos\theta)$$

$$W \propto \frac{1}{\sigma_x^2}$$

$$(E_i)_S = (E_0)_S + k[(E_i)_U\,cos\theta + (N_i)_U\,sin\theta]$$

$$(N_i)_S = (N_0)_S + k[-(E_i)_U\,sin\theta + (N_i)_U\,cos\theta]$$